

U.S. Patent Application Serial No. 10/553,237

Response filed August 21, 2008

Reply to OA dated May 21, 2008

REMARKS

Claims 1-8 are currently being examined in the present application. Claim 1 is the sole independent claim. Claims 1, 4, and 5 have been amended to more distinctly claim and point out the applicant's invention. Claim 6 has been canceled. It is asserted that no new matter is contained herein and that these amendments, along with the accompanying remarks, are fully responsive to the office action dated May 21, 2008.

The Examiner has rejected claims 1-6 under 35 U.S.C. § 102(b) as being anticipated by Johnson (U.S. Patent No. 3,812,682). Claim 6 is canceled through this amendment, making the rejection to claim 6 moot.

The Examiner's position regarding Johnson is found on page 2 of the present action. The Examiner's position is summarized in that Johnson discloses in Fig. 13 a pair of cylinders 142 and 143, which are shown as being disposed in parallel. Each cylinder contains therein a displacer piston 144 (or 151) and a power piston 146 (or 152). The opposite ends of each cylinder are in communication with a heat exchanger 162, which is made up of a heater H, a regenerator R and a cooler C. Although the two heat exchangers 162 are shown between the two cylinders 142 and 143 in Fig. 13, this merely teaches that the two heat exchangers 162 are located between the two cylinders 142 and 143.

The examiner has further rejected claims 1-6 under 35 U.S.C. § 102(b) as being anticipated by Joynes et al. (U.S. Patent No. 4,020,635). Claim 6 is canceled through this amendment, making the rejection to claim 6 moot.

The Examiner's position regarding Joynes et al. is described on page 2 of the present action. This position is summarized in that Joynes et al. discloses in Fig. 1 a pair of cylinders 1 and 2 that are shown as being disposed in parallel, similar to Johnson. Each cylinder contains therein a displacer piston 5 (or 6) and a power piston 7 (or 8). The opposite ends of the cylinder 1 are in communication with a heat exchanger, which is made up of a heater 29, a regenerator 33 and a cooler 31. The opposite ends of the other cylinder 2 are in communication with a heat exchanger, which is made up of a heater 30, a regenerator 34 and a cooler 32. The heat exchanger cooperating with the cylinder 1 integrally attached thereto, while the other heat exchanger cooperating with the cylinder 2 is also integrally attached thereto.

More particularly, it is the applicant's view that in Joynes et al., the two heat exchangers are spaced apart and are connected through pipes. The cooling liquid used in liquid hydrogen stored in a tank 38. The tank 38 sends out the liquid hydrogen and supplies the same to the left-side cooler 31. The same liquid hydrogen is assumed to be supplied also to the right-side cooler 32. The liquid hydrogen supplied to the left-side cooler 31 cools the working fluid and is heated by the working fluid. The heated hydrogen is then supplied through a pipe 41 to a combustion

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chamber 42 and is burned therein to produce a combustion gas. The combustion gas is sent via a pipe 46 to the left-side heater 29 to heat the working fluid and is discharged to the outside through a pipe 47. Similarly, the combustion gas produced in the combustion chamber 42 is supplied through a pipe 50 to the right-side heater 30. It is to be noted that the two cylinders 1 and 2 are spaced apart by a sufficient distance from each other to provide a space for the combustion chamber 42 and the connecting pipes between the two cylinders 1 and 2.

In contrast to the references cited by the Examiner, the multistage Stirling engine, as claimed in the present application, calls for:

- A. a plurality of heat exchangers including adjacent cylinders (4, 5) disposed in parallel arrangement;
- B. heat exchangers (40, 41) being each in the form of a stack of each heater, each regenerator, and each cooler;
- C. two of the heat exchangers (40, 41) forming adjacent stacks are interposed closely between adjacent two cylinders of the plurality of cylinders (4, 5) to form an integral structure having a shape of a flat rectangular solid including adjacent cylinders (4, 5) and the heat exchangers (40, 41).

Of the above listed features of the invention, C is particularly important. The combination of these features is not taught by Johnson or Joynes et al., either singularly or in concert.

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According to Claim 1 as presently amended, the two heat exchangers are formed as a stack and are interposed closely between the adjacent two cylinders in such a manner as to form an integral structure having a shape of a flat rectangular solid including the adjacent cylinders (4, 5) and the heat exchangers (40, 41). This means that the spacing between the two adjacent cylinders is equal to the combined size of the two heat exchangers, so that the two heat exchangers are closely fitted in a space between the adjacent cylinders. It will be readily understood that in either Johnson or Joynes et al., that the heat exchangers only partly occupy the space between the two adjacent cylinders.

This feature of claim 1 finds support in the paragraph bridging pages 16 and 17 of the specification, and is advantageous, for among other reasons, in that the Stirling engine can be produced in a compact structure having a simple shape of a flat rectangular solid with small dimensions, whereby the engine can be easily installed into a small engine compartment of a vehicle. This structure of claim 1, and also claims 2-5 through their ultimate dependence on claim 1, provides its associated benefit in a manner not contemplated or suggested by either Johnson or Joynes et al..

Based on the amendments to claims 1, 4, and 5, along with the preceding remarks, claims 1-5 are now believed to be patentable. Withdrawal of the rejections of claims 1-5 under 35 U.S.C. § 102(b) are now in order and respectfully solicited.

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The examiner has rejected claims 7-8 under 35 U.S.C. § 103(a) as being unpatentable over Johnson (U.S. Patent No. 3,812,682), and also rejected these claims under 35 U.S.C. § 103(a) for being unpatentable over Joynes et al. (U.S. Patent No. 4,020,635). The Examiner in making this rejection acknowledges that neither Johnson, nor Joynes et al., discloses the specific location of the generator and heat exchangers in the same unit, but asserts that a person having ordinary skill in the art would understand the inventions of claims 7 and 8 to be obvious in light of the cited disclosures.

Due to claims 7 and 8 depending upon claims 1 and 2, which are now patentable, claims 7 and 8 are also now believed to be similarly patentable. As such, withdrawal of the outstanding rejections to claims 7 and 8 under 35 U.S.C. § 103(a) is now in order and respectfully solicited.

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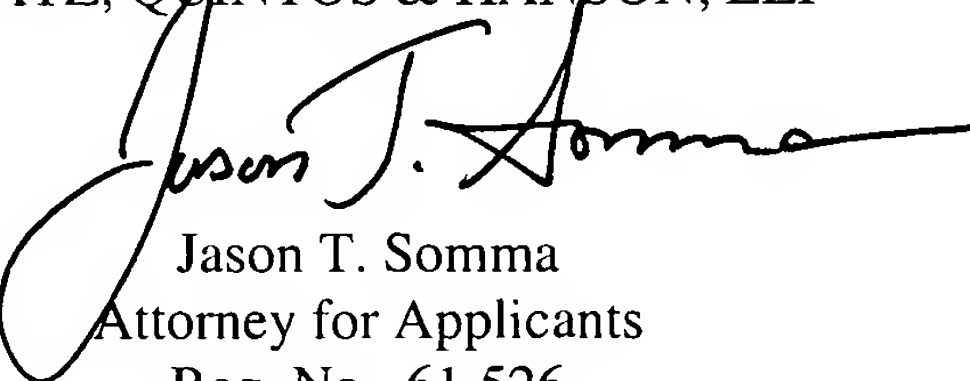
Claims 1-5, 7 and 8 are now in condition for allowance, which action, at an early date, is requested.

If, for any reason, it is felt that this application is not now in condition for allowance, the Examiner is requested to contact the applicants undersigned attorney at the telephone number indicated below to arrange for an interview to expedite the disposition of this case.

In the event that this paper is not timely filed, the applicants respectfully petition for an appropriate extension of time. Please charge any fees for such an extension of time and any other fees that may be due with respect to this paper, to Deposit Account No. 01-2340.

Respectfully submitted,

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